

# Protein Power Game

## Teacher Information

**Objective:** Students will assume the functions of various cell organelles and RNA to simulate cell processes and protein synthesis. They will compete against other classes to determine which "cell" has the lowest time for creating six proteins.

### Materials:

- Cell Part Necklaces - Print on card stock, cut apart, and then laminate. Use a hole punch and yarn to create necklaces for each organelle or part.  
NOTE: You will need to adjust the number of cards you use depending on the size of your classes. For larger classes, add up to two chromatin, one Golgi body, and two tRNA molecules. For smaller classes, use only three ribosomes and three mRNA molecules as well as reduce the number of lysosomes, cell membranes, and ERs to one. Try to keep the number of ribosomes equal to the number of mRNA molecules with half as many tRNA molecules.
- Protein Patterns - Need 4 copies of this page. Use two of them for the "cell membrane" to use to check for accuracy and cut apart the other two for the chromatin.
- Legos - Need the pieces listed at right or you can create your own structures using the pieces you have available.
- Copies of the student worksheet
- Access to a computer or other device for the PowerPoint presentation
- Timer or stopwatch

Blue - $2 \times 2 = 3$ , $2 \times 4 = 6$
White - $1 \times 2 = 7$ , $2 \times 2 = 1$ , $2 \times 4 = 5$
Red - $2 \times 4 = 8$
Yellow - $1 \times 2 = 7$ , $2 \times 2 = 3$

### Procedure:

1. Prepare the game materials as listed above. You will also want to designate an area in your classroom for the nucleus, such as a specific table or desk. Spread the Lego pieces (amino acids) on another table or several desks. You will want to space the nucleus and ribosomes on opposite ends of the room with the amino acid table located in between the two. See my classroom diagram on the PowerPoint presentation.
2. Complete Section 1 on the student worksheet using the PowerPoint presentation and discuss the game rules listed below.

### **Game Rules**

- (1) Cell parts must perform the correct functions. If you do not, you will be sent to a lysosome and kept out of the game for 30 seconds before you can be "recycled" and return to the game. If you are sent to a lysosome, you must stay with that person until you are "recycled".
- (2) Ribosomes can only work on one protein at a time with the help of one mRNA molecule and the tRNA molecules. The tRNA molecules must stay near the table with amino acids unless they are delivering pieces.
- (3) Cell parts cannot run around the classroom or shove other cell parts.
- (4) You must keep the same role for an entire round and are not allowed to have the same role more than once during the entire game.
- (5) There will be a total of 4 rounds during which your cell (class) must make a total of 6 correct proteins. Your best time will be used to determine the most efficient cell (class). Every organelle/part must have done something in order for the score to count.

3. Review the functions of each part of the cell. Assign jobs by distributing the game necklaces and allow time for students to fill in the first row on the chart on the student worksheet.

<b>Cell Part</b>	<b>Game Tasks</b>
<b>Lysosome</b>	"Breaks down" proteins that are not correct (either from the cell membrane or a ribosome) and "recycles" organelles that have not done their job correctly.
<b>mRNA</b>	Get instructions for a protein from the chromatin and tell a ribosome how to make the protein. The tRNA molecules cannot hear or talk to you.
<b>tRNA</b>	Helps a ribosome by gathering the pieces it needs for a specific protein. You will need to stay near the amino acids unless you are delivering pieces.
<b>Ribosome</b>	Gets instructions from the mRNA, tells the tRNA to get the pieces needed, and assembles the protein. Calls for an ER to pick up completed proteins.
<b>ER</b>	Gets a protein from a ribosome and takes it to a golgi body.
<b>Golgi Body</b>	Gets two proteins from two ribosomes and takes the set to the cell membrane. You must have at least two proteins before you can hand them off.
<b>Chromatin</b>	Shows a protein pattern to the mRNA molecule when it enters the nucleus. The ribosomes and other organelles should not be allowed to see the pattern.
<b>Cell Membrane</b>	Check the proteins. If it is correct, pass through the membrane to the teacher. If not, yell for a lysosome to get it for recycling.

NOTE: If a ribosome ends up with the incorrect pieces, a lysosome must take all the pieces they have at that time and recycle them! The ribosome must start building that protein again. Protein that have already been approved by the cell membrane are safe.

4. Use a timer to determine the time it takes the cell (class) to make 6 correct proteins. Record this amount on the chalkboard or a score sheet.
5. At the end of a round, collect the necklaces and redistribute. Allow time for students to fill in the second row on the chart on the student worksheet.
6. After completing four rounds of the game, allow time for students to answer the questions on the back of the worksheet and discuss.

## **Variations:**

### Ideas to make the game easier:

- You might consider acting as the cell membrane to ensure the proteins are correct. Allow ribosomes one chance to correct the protein before sending it to a lysosome.
- Add more tRNA molecules so that there are enough for each ribosome.
- Make different proteins that will be easier to make, such as those limited to 4 or less pieces.

### Ideas to make the game more challenging:

- Require the chromatin to tell (not show) the mRNA molecule what it will need. mRNA are not allowed to look at the protein patterns.
- Build more difficult proteins than those shown on the pattern card. You might also limit the number of pieces and require ribosomes to make a different protein when they cannot get the correct ones.